GarrettCom™

Ethernet at Its Best™

Magnum 14E Fast Ethernet Media Converters

(Including SC, ST and MTRJ ports, full/half duplex, mm and sgl. mode, standard Link Pass-through)

Magnum™ 14E Media Converters

Installation and User Guide

Part #: 84-00065 Rev E

Trademarks

Ethernet is a trademark of Xerox Corporation

NEBS is a trademark of Telcordia Technologies

UL is a registered trademark of Underwriters Laboratories

GarrettCom, Magnum and **Personal Switch** are trademarks and **Personal Hub** is a registered trademark of GarrettCom, Inc.

Important: The Magnum 14E Media Converters contains no user serviceable parts. Attempted service by unauthorized personnel shall render all warranties null and void. If problems are experienced with Magnum 14E Media Converters, consult Section 5, Troubleshooting, of this User Guide.

Copyright © 2001 GarrettCom, Inc. All rights reserved. No part of this publication may be reproduced without prior written permission from GarrettCom, Inc.

Printed in the United States of America.

Contacting GarrettCom, Inc

Please use the mailing address, phone and fax numbers and email address listed below:

GarrettCom, Inc.

47823 Westinghouse Drive

Fremont, CA 94539

Phone (510) 438-9071

Fax (510) 438-9072

Website: http://www.GarrettCom.com

email support@garrettcom.com

Federal Communications Commission

Radio Frequency Interference Statement

This equipment generates, uses and can radiate frequency energy and if not installed and used properly, that is in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

TABLE OF CONTENTS **Page**

1.0 SPECIFICATIONS 1
1.1. Technical Specifications 1
1.2 Ordering Information 6
2.0 INTRODUCTION 7
2.1 Inspecting the Package and Product 7
2.2 Product Description 9
2.3 Features and Benefits 14
2.4 Applications 16
3.0 INSTALLATION 20
3.1 Locating the Media Converter Unit 20
3.2 MC14-TRAY for Rack mounting the Magnum 14E 21
3.3 MC14-TR+PS9 & MC14-TR+PS9X2 19" Rack-mount w/ Power Supply . 23
3.4 Calculating Overall Segment Distances 25
3.4.1 Power budget calculation for fiber media 25
3.4.2 Segment Distance, full-duplex copper (RJ-45) and fiber 27
3.4.3 Segment Distances for half-duplex mode 32

TABLE OF CONTENTS (CONTINUED) ..... Page

3.4.4 Collision Domain (PDV Calculations) 32
3.5 Connecting Fast Ethernet Media 40
3.5.1 Connecting Twisted Pair (RJ-45 Standard) 40
3.5.2 Connecting Fiber-FX (SC-type “Snap-In”, and ST, "Twist-Lock") 41
3.5.3 Connecting Fiber-FX (MT-RJ-type Small Form Factor “Snap-In”) 43
4.0 OPERATION 44
4.1 Power Requirements, Power Supply Types 44
4.2 Dual LEDs (Front and Side) Indicators 45
4.3 Up-Link Switch on TX port 46
4.4 Manual AN/reg (auto-negotiate support, or regular operation) Switch 47
4.5 Standard Link Pass-through feature in all Magnum 14E Models 50
5.0 TROUBLESHOOTING 52
5.1 Before Calling for Assistance 53
5.2 When Calling for Assistance 54
5.3 Return Material Authorization (RMA) Procedure 55
5.4 Shipping and Packaging Information 57
APPENDIX A: WARRANTY INFORMATION 58

Revisions

Rev E 10/02 : Link-Pass-through feature updated in this revision.

Rev D 09/01 : MC14-TR+PS9 and MC14-TR+PS9X2, 19" Rack-mount with Power Supply added in this revision.

Rev C 04/01 : Change the company name to GarrettCom, Inc. (Formerly it was Garrett Communications). There are no changes to the content of the material at this time.

Rev B 09/00 : Manual AN/reg (auto-negotiate support, or regular operation) Switch information added.

Rev A 05/00 : This revision is the initial release of the 14E media Converters user manual.

1.0 SPECIFICATIONS

1.1. Technical Specifications

Performance:

Data Rate: 100 Mb/s

Half- or Full-Duplex transparent, F/H auto-negotiation supported

200ns (20 bit-times) Path Delay Value (PDV) for conversion delay

Network Standards:

Fast Ethernet IEEE 802.3u: 100BASE-TX, 100BASE-FX

Operating Environment:

Ambient Temperature: 32°F to 120°F (0°C to 50°C)
Storage Temperature: -20°C to 60°C
Ambient Relative Humidity: 10% to 95% (non-condensing)

Maximum Standard Fast Ethernet Segment Lengths:

100BASE-TX (twisted pair):	100 m (328 ft)
100BASE-FX Fiber optic, half-duplex: (multi-mode)	412 m (1350 ft)
100BASE-FX Fiber optic, full duplex: (multi-mode)	2.0 km (6,562 ft)
100BASE-FX Fiber optic, half-duplex: (single-mode)	412 m (1350 ft)
100BASE-FX Fiber optic, full duplex: (single-mode)	25 km (66k ft)
100BASE-FX Long Reach: Fiber optic, full duplex: (single -mode)	40 km (132k ft)

Note: Magnum 14E Media Converters DO NOT support full length shared Fast Ethernet segments. See Section 3.2 of this manual for media lengths and shared segment distance calculations.

Power Supply (External):

Power Input: 95 - 125 vac at 60 Hz for "-d" Models,
100 - 240 vac at 50 Hz for "-i" Models which have IEC power cable connector.
Power Consumption: 4 watts typical
Power Adapter: 9VDC, 1.0 Amps; center positive
Note: Optional –48vdc and 24vdc external power units are available

Connectors:

RJ-45 Port: 8-Pin female, with "cross-over" up-link switch

Note: The AN/reg manual switch is for user-selected auto-negotiation support, or for regular operation. See Section 4.4

Fiber, multi-mode (up to 2Km) :

SC-type (snap-in): Fiber optic multi-mode, 100BASE-FX

ST-type (twist-lock): Fiber optic multi-mode, 100BASE-FX

MT-RJ-type, Small Form Factor (plug in): Multi-mode, 100BASE-FX

Fiber, single-mode (25-Km and up):

SC-type (snap-in): Fiber optic single-mode, 100BASE-FX, 25Km

SC-type (snap-in): "Long-Reach" single-mode, 100BASE-FX, 40Km

Packaging:

Enclosure: High strength sheet metal.

Dimensions: 3.5 in H x 3.0 in W x 1.0 in D (8.9 cm x 7.6 cm x 2.5 cm)

**Power Supply: 2.0 in x 2.0 in x 1.5 in (5.1 cm x 5.1 cm x 3.8 cm)

Weight: 4.6 oz. (130 gr); Power Supply 1.0 lb (455 gr)

LED Indicators for the Magnum 14E (Dual, on front and on end) :

PWR Indicates unit is receiving DC power.

Note: Magnum 14E has Link Pass-through feature, see Section 4.5

LINK, Fiber port Steady ON when both attached cable segments are operational at their respective other ends, blinking when receiving remote fault from the other end.

LINK, Copper port Steady ON when the attached cable segments are operational at their respective other ends

RX/ACT Activity, blinking indicates port is receiving

Agency Approvals:

UL Listed (UL 1950), cUL , CE Certified

Emissions: Meets FCC Part 15 Class B, cUL, CE

Warranty: Three years, return to factory Made in USA

1.2 Ordering Information

Model Number	Description
Magnum 14E-SC-d	Twisted pair to mm fiber SC, ext. 115 vac, 60Hz power supply
Magnum 14E-SC-i	Twisted pair to mm fiber SC, ext. 230 vac, 50Hz power supply
Magnum 14E-ST-d	Twisted pair to mm fiber ST, ext. 115 vac, 60Hz power supply
Magnum 14E-ST-i	Twisted pair to mm fiber ST, ext. 230 vac, 50Hz power supply
Magnum 14E-MT-RJ-d	Twisted pair to fiber MT-RJ small form factor, ext. 115 vac, 60 Hz PS
Magnum 14E-MT-RJ-i	Same as Magnum 14E-MT-RJ, but with ext.230 vac, 50 Hz PS
Magnum 14E-SSC-d	Twisted pair to fiber SC, single-mode std 25Km, ext. 230vac, 50 Hz PS
Magnum 14E-SSC-I	Same as Magnum 14E-SSC, but with ext 230vac, 50 Hz PS
Magnum 14E-SSCL-d	Twisted pair to fiber ST, single mode 40km "Long Reach", external 115vac, 60 Hz Power Supply
Magnum 14E-SSCL-i	Same as Magnum 14E-SSCl, but with ext 230vac, 50 Hz PS
MC14-TR+ PS9 = 19" Rack-mount tray , support upto 10 units of 100Mbps 14E Fiber Media Converters,Uses 2U rack space, has space for a few external PS units (which are part of the MC's)	
MC14-TR+PS9X2 = Powered 19" Rack-mount tray for 100Mb, 14E (and 10Mbps, TF14 mix and match) Media Converters, up to 16 units @ 9vdcs. Uses 2U rack space. Includes common multi-unit Power Supply for universal AC input, 55 watts at 9vdc, and power cabling for the MC's	

GarrettCom, Inc. reserves the right to change specifications, performance characteristics and/or model offerings without notice.

2.0 INTRODUCTION

This section describes the Magnum 14E Fast Ethernet Media Converters, including appearance, features and possible applications.

2.1 Inspecting the Package and Product

Examine the shipping container for obvious damage prior to installing this product; notify the carrier of any damage which you believe occurred during shipment or delivery. Inspect the contents of this package for any signs of damage and ensure that the items listed below are included.

This package should contain:

1	Magnum 14E Media Converter unit
1	External Power Supply, either 115 vac 60 Hz or 230 vac 50 Hz

1	Set of two (2) metal mounting clips, with screws
1	Velcro® Tape section, approximately 3 inches in length
1	User Guide (this manual) and Product Registration Card

Remove the Magnum 14E Media Converter from the shipping container. Be sure to keep the shipping container should you need to store or to ship the unit at a later date. To validate the product warranty, please complete and return the enclosed Product Registration Card to GarrettCom, Inc. within two weeks of purchase.

In the event there are items missing or damaged, contact your supplier. If you need to return the unit, use the original shipping container. Refer to Section 5, Troubleshooting, for specific return procedures.

2.2 Product Description

Magnum 14E Fast Ethernet Media Converters offer a convenient, cost-effective and graceful way to incorporate fiber media into a 100BASE-TX Ethernet network. Each Magnum 14E supports both full- and half-duplex mode transparently so that an attached RJ-45 switch or hub operates at its highest performance level. For support of "N-way" auto-negotiating switches, a manual AN/reg switch on the Magnum 14E allows the user to manually enable either (a) "AN" for auto-negotiation, where the 14E transmits applicable auto-negotiation Fast Link Pulses (FLPs) from the RJ-45 port to the connected 10/100 switch port at Link-enable, or (b) "reg" regular media converter mode, no auto-negotiation.

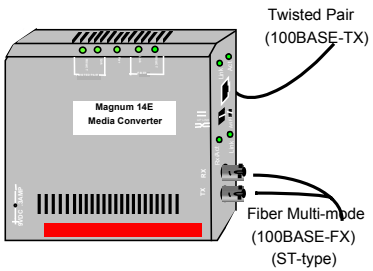
Magnum 14E Media Converters are designed for quick and easy installation even in very tight spaces. Media cables are easily attached. Magnum 14E Media Converters feature an up-link switch on the TX port to eliminate the need for a special cross-over cable when

connecting the TX port to a switch or hub. Because of their compact size, Magnum Media Converters can be Velcro®-mounted on an office wall or the side of a desk or cabinet. The external power supply, 115vac 60Hz or 230vac 50Hz, plugs into a nearby AC wall socket or power strip. Each 14E Media-Converter features a two full sets (front and side) of LEDs that convey essential status information in any mounting arrangement. See Section 4.1, LED Indicators, for LED function information.

Magnum 14E Media Converters are designed to operate at high ambient temperatures over an extended period, making them some of the most reliable in the industry. Their high-strength fabricated metal packaging shields against Radio Frequency Interference (RFI) and Electromagnetic Interference (EMI), avoiding interference with other nearby electronic devices.

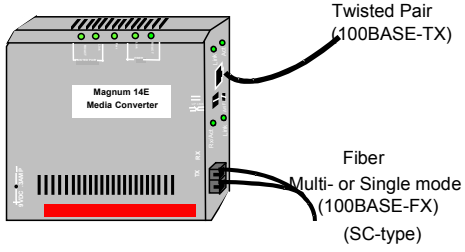
The Magnum 14E units comply with the IEEE 802.3u (100BASE-TX and 100BASE-FX) specification for 100 Mb/sec traffic via shielded (STP) or unshielded twisted pair (UTP) segments.

The Link Pass-Through feature is especially desirable for use in managed networks, and is standard in all 14E's. Magnum 14E-ST models are equipped with one multi-mode fiber-ST and one RJ-45 connector for connection into 100BASE-FX segments.



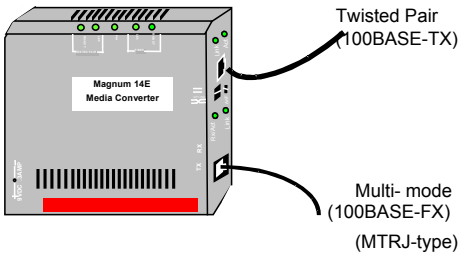
14Es with ST integrates 100BASE-TX and FX networks, with fiber ST connector

The Magnum 14E-SC comes in three models, with three different fiber transceivers. Models are 14E-SC (multi-mode, 2Km), 14E-SSC (single-mode, 25Km) or 14E-SSCL (single-mode Long Reach, 40Km) are equipped with one fiber SC-type port and one RJ-45 port for connection into 100BASE-FX and 100BASE-TX compliant Fast Ethernet network segments.



14Es with SC integrate 100BASE-TX and FX networks, with fiber SC connectors.

The Magnum 14E-MTRJ (SFF, small form factor) comes with multi-mode fiber transceivers. The Model 14E-MTRJ (multi-mode, 2Km), equipped with one fiber MTRJ-type port and one RJ-45 port, connects into 100BASE-FX and 100BASE-TX compliant Fast Ethernet network segments. The SFF MT-RJ connector is keyed so that it can only be connected when the two fiber strands are correctly positioned for transmit and receive. See Section 3.4.3.



14Es with SC integrate 100BASE-TX and FX networks, with fiber MT-RJ connectors.

2.3 Features and Benefits

- **Reduces Network Costs**
  Magnum 14E Media Converters offer an ideal solution to quickly and inexpensively connect Twisted-Pair TX with Fiber FX cabling.

- **Full-duplex or Half-duplex transparent, auto-negotiation support**
  Magnum 14E's support both full-duplex and half-duplex mode transparently, and are suited for use with 100Mb Ethernet switches supporting (or not supporting) auto-negotiation.

- **Low PDV for Maximum Cable Lengths in Shared Segments**
  Magnum 14E Media Converters add signal timing delays of only 20 Bit Times in a shared half-duplex segment, much less than a Class II (90 to 95 BT), and can be used to attach fiber cables to TX ports with low distance loss in an overall HDX collision domain.

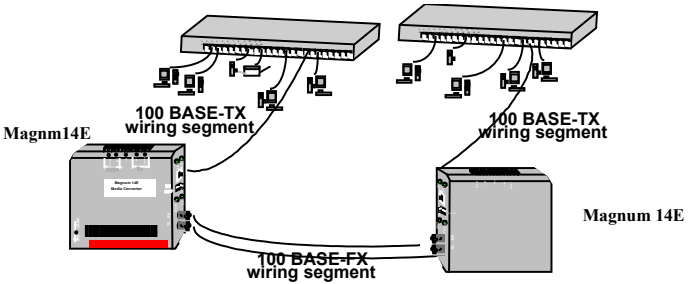
- **Small, Compact, Lightweight Design**
  Featuring a compact and lightweight metal case with an external power supply, Magnum 14E Media Converters can be conveniently installed in minimal space. The MC14-TRAY provides optional rack-mounting.
- **Two sets of LEDs for viewing status from any angle.**
  Each 14E Media Converter is equipped with a two sets (front & side) of LEDs to provide status information when viewed at any angle or mounting arrangement, rack-mount Tray or wall-mount.
- **Choice of 100Mb Ethernet Fiber port connector types**
  Models of the Magnum 14E's are available with all of the popular fiber connectors: ST, SC mm and sgl-mode, and MT-RJ SFF (small form-factor).
- **Link Pass-through is standard** This feature, desired mainly in managednetworks, is standard in all Magnum 14E's.

2.4 Applications

The primary function of a Magnum 14E Media Converter is to permit two different media types to coexist within the same network by allowing data to be transmitted / received between different media types. Magnum 14E media converters provides an effective solution for a network environment where auto-negotiation is a primary concern for the attached devices. They also support 100Mb half duplex or full duplex mode, transparent. Because of its auto-negotiation feature, the Magnum 14E supports an attached "N-way" auto-negotiating RJ-45 switch or hub port, allowing it to operate at its highest performance level, i.e., full-duplex 100Mb/s.

Magnum 14Es are typically used where new 10/100Mb switches or switching hubs with auto-negotiating RJ-45 ports are being installed, and where full-duplex fiber segments (of up to 2Km for multi-mode or 25Km to 40Km for single mode) are needed

to interconnect them with other 100Mb switches or switching hubs in distant wiring closets. Alternatively, a server with a full-duplex NIC may need to be connected via fiber to a 100Mb switches or switching hubs with RJ-45 ports.

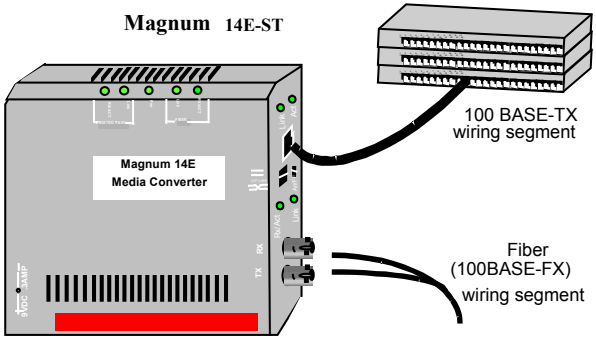


Two Magnum 14E's provide connectivity for 100Mbps switches or hubs via fiber

In these and similar situations, the Magnum 14E conveniently converts the twisted pair cable to fiber, allowing use of any available RJ-45 Fast Ethernet switched port with a new or existing fiber cable. See Section 3.2.1 for cable distance calculation information.

Where shared Fast Ethernet segments are used, such as with Fast Ethernet switches or switching hubs with RJ-45 ports, it may be desirable to connect one or more servers or users via fiber cable. Because of its manual AN/reg switch feature, the Magnum 14E supports both "Auto-negotiation" and "reg" regular mode at the attached RJ-45 port, allowing flexibility with the unit attached. See Section 3.4.3 for details on auto-negotiation support.

It is necessary to calculate the PDV of the overall collision domain (see Section 3.2.2) for proper operation of the Magnum 14E in HDX applications.



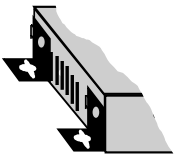
A typical Magnum 14E application is to convert copper media to fiber, with auto-negotiation support for the attached device on the copper port.

3.0 INSTALLATION

This section describes the installation of the Magnum 14E Media Converters, including location, segment distance calculation and media connection.

3.1 Locating the Media Converter Unit

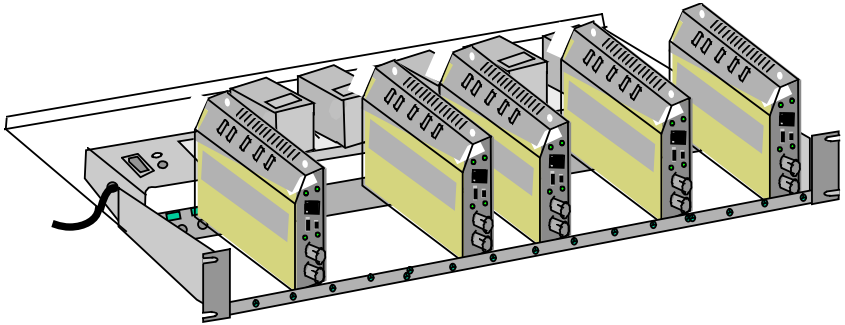
The compact and lightweight design of the Magnum 14E Media Converter allows it to be easily installed in most any location. A Velcro strip and a set of two metal clips and screws are included (either may be used) for mounting the unit on a vertical surface such as a wall or cabinet, or for securing the unit on a table-top or shelf. The installation location is dependent upon the physical layout of the Ethernet network and associated cabling. Make sure the unit is installed in a location that is easily accessible to an AC power outlet or power strip, and where convection cooling is not inhibited.



Proper attachment of metal mounting clips for secure mounting

3.2 MC14-TRAY for Rack Mounting of Magnum 14E Media Converters

For 19" rack-mounting of Magnum 14E Media Converter, a rack-mount tray is available, MC14-TRAY. The Media Converter units are mounted with their DC power jack in the back, and with the RJ-45 and the fiber ports in front. Any mix of the "14"-series 10Mb Media Converters and 14Es may be placed on a tray, up to a maximum



of 16 units. (The mounting spaces of the MC14-TRAY are specific to the 10Mb "14"-series and the 14E, and do not permit other models or other sizes to be put in the tray).

A typical installation of the model MC14-TRAY, 19" rack-mount tray will hold a few (often three to eight) 14E Media Converters, each with their power supply plugged into power strips (not included) in the rear area of the tray. Metal mounting screws in the bottom-

front hold the media converters firmly in place in the tray.

3.3 MC14-TR+PS9 & MC14-TR+PS9X2 for Rack Mounting 100Mbps Crossover Media Converters

The MC14-TR+ PS9 and MC14-TR+PS9X2 are another option available for Rack Mounting the mix-match of 10Mbps and 100Mbps Media Converters together in 19" rack-mount tray. These models comes with built-in common universal AC power supply rated at 55 watts at 50C ambient, 9VDC output, and supporting up to 10 MC for MC14-TR+PS9 and 16 units of Fiber media converters for MC14-TR+PS9X2. The MC14-TR+PS9X2 Model has two groups of eight units per power supply. These models are equipped with Auto-ranging AC input to the power supplies for use worldwide.

(The MC mounting spaces of the MC14 -TR models are specific to the Magnum 10Mbps (TF14) and 100MB (14E) series, and do not permit other models or other sizes to be put in the tray).

The side-view picture shown here is an example of an installation of the model MC14-TR+PS9, 19" rack-mount tray, holding a few 100Mbps 14E Media Converters, each with their power input plugged into the built-in common AC power supply in the rear area of the tray. (PS units that come with the MC's are not used).

Metal mounting screws in the bottom-front hold each of the media converters secure in the tray, separately removable for service. The dual LEDs permit viewing operating status of the Media Converters from any angle.

3.4 Calculating Segment Distances

The media distance considerations are quite different for full-duplex and for half-duplex (standard Fast Ethernet) installations. Each of these situations are covered below in a separate section.

3.4.1 Power Budget Calculations for Fiber Media

Receiver Sensitivity and Transmitter Power are the parameters necessary to compute the power budget. To calculate the power budget of different fiber media installations, the following equations should be used:

OPB (Optical Power Budget) = P_T(min) - P_R(min)

where P_T = Transmitter Output Power, and P_R = Receiver Sensitivity

Worst case OPB = OPB - 1dB(for LED aging) - 1dB(for insertion loss)

Worst case distance = {Worst case OPB, in dB} / [Cable Loss, in dB/Km]

where the "Cable Loss" for 62.5/125 and 50/125μm (m.m.) is 2.8 dB/km,
and the "Cable Loss" for 100/140 (multi-mode) is 3.3 dB/km,
and the "Cable Loss" for 9/125 (single-mode) is 0.5 dB/km

The following data has been collected from component manufacturer's (HP's and Siemens') web sites and catalogs to provide guidance to network designers and installers.

Fiber Port Module	Speed, Std.	Mode	Std. km fdx (hdx)	Wave-length nm	Cable Size µm	X'mitr Output P_T, dB	R'cvr Sens. P_R,dB	Worst OPB, dB	Worst* distance Km, fdx	typical OPB, dB	typical* distance Km, fdx
14E-MST, MSC	**100Mb FX**	Multi-mode	2 (0.4)	1300	62.5/125 50/125	-20 -23.5	-31 -31	9.0 5.5	2.5 2.0	14 12	5 4
14E-SSC	**100Mb FX**	Single-mode	25 (0.4)	1300	9/125	-15	-31	14	28	17.5	35
14E-MTRJ	**100Mb FX**	Multi-mode	2 (0.4)	1300	62.5/125 50/125	-20 -23.5	-31 -31	9.0 5.5	2.5 2.0	14 12	5 4
14E-SSCL Long Reach	**100Mb FX**	Single-mode	40 (0.4)	1300	9/125	-5	-34	27	54	32.5	65

** **Note**: The use of either multi-mode or single-mode fiber to operate at 100Mbps speed over long distances (i.e., over approx. 400 meters) can be achieved* **only** *if the following factors are both applied:*

- *The 100Mb fiber segment must operate in full-duplex (FDX) mode, i.e. a switch (or equal external unit such as a FDX NIC) must be used, and*
- *The worst-case OPB of the fiber link must be greater than the fiber cable's passive Attenuation.*

(Attenuation = Cable loss + LED aging loss + Insertion loss + safety factor)

3.3.2 Segment Distances, Full-duplex for copper media (RJ-45) and fiber

Full-duplex ports, such as copper are found in switching hubs and some NICs, can receive and transmit signals simultaneously and do not experience collisions accordingly. There may be only two nodes present on a full-duplex segment. Media distance rules are not the same as for standard (half-duplex) Fast Ethernet because collision distance limitations are not a factor. Specifically, fiber segments can be up to 2Km for multi-mode and up to 25Km for single mode (or 40Km for "Long Reach" single mode).

The Magnum 14E, with full-duplex operation as a standard feature, can be used in these applications. When installing the Magnum 14E in a full-duplex segment, it is important to consider the combined overall segment length of both of the attached media types. The overall segment length is calculated by adding together the segment lengths on both sides of the Magnum 14E Media Converters. The figure below illustrates how a Magnum Media Converter is used to connect a multi-mode fiber (100BASE-FX) with a twisted pair (100BASE-T) segment.

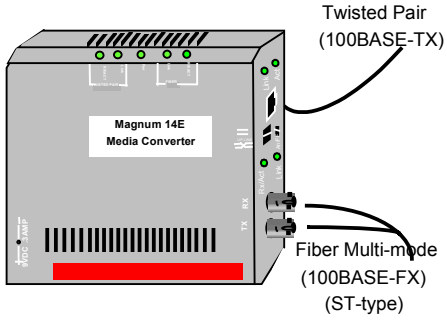
Segment length on each side of the 14E Media Converter is measured as a percentage of the maximum allowable standard media distance for the given media type. The percentages, when added together, must not exceed 100%.

Media Distance Formula for Magnum 14E, full-duplex:
X% + Y% ≤ 100%

Where **X** = The segment distance on one side of the Magnum 14E Media Converter divided by the Standard Maximum Media Distance for that media type, x 100%

Where **Y** = The segment length on the other side of the Magnum 14E Media Converter divided by the Standard Maximum Media Distance for that media cabling type, x 100%

Connectivity between 100BASE-TX and 100BASE-FX Ethernet Media.



In the example figure shown above, the length of fiber Segment X is 1500m (4920 ft). This is 75% of the maximum allowable distance for multi-mode 100BASE-FX fiber full-duplex media (2000 m) [75/2000 x 100% = 75%]. The length of twisted pair Segment Y is 10m (33 ft). This is 10% of the maximum allowable distance for 100BASE-TX full-duplex twisted-pair media (100 m) [10/100 x 100% = 10%]. The total of the two percentages (75% + 10%) is 85%, which is allowable.

Note 1: Where more than one media converter is used in one segment run, the percentages for all of the cabling lengths in the run must be added together and must not exceed 100%.

In another instance, a Magnum Media Converter is used to connect a ***single*** mode fiber (100BASE-FX) with a twisted pair (100BASE-T) segment. In this example, the length of fiber Segment X is 8500m (27,880 ft). This is 57% of the maximum allowable distance for single mode 100BASE-FX fiber full-duplex media (15,000 m) [57/15,000 x 100% = 57%]. The length of twisted pair Segment Y is 12m (40 ft).

This is 12% of the maximum allowable distance for 100BASE-TX full-duplex twisted-pair media (100 m) [12/100 x 100% = 12%]. The total of the two percentages (57% + 12%) is 69%, which is allowable.

3.4.3 Segment Distances, Half-duplex mode

Fast Ethernet shared bandwidth devices operate with multiple nodes in a traffic domain. When a node attempts to send a packet, it may hit another packet passing by, i.e., a collision may occur. This is normal and does not cause a problem because the Ethernet protocol provides for this situation and requires that the sender wait and try again. When installing the Magnum 14E in a half-duplex segment, it is important to consider the collision domain of the segment, including the 14E itself, repeaters and hubs present, and the lengths of both of the attached media types.

3.4.4 Collision Domain (PDV Calculations)

A collision domain is defined in the IEEE 802.3u standard as a cluster of network devices that, regardless of topology, must be less than 512 BT (Bit Times) of signal delay

(PDV or Path Delay Value) in diameter between any two nodes. Nodes in a collision domain are connected by means of a repeater or repeaters such that no bridging or switching devices are present between any two nodes in the cluster. A Magnum 14E has a PDV of about eighty Bit Times (20 BT), and this value must be included in the overall collision domain diameter PDV calculations as applicable for the placement of the 14E in the topology of the collision domain.

Collision Domain Diameter

The Collision Domain Diameter is the length of the longest path between any two devices in a single collision domain. Regardless of the actual network topology, the Collision Domain Diameter must be less than 512 BT (Bit Times). Bit Times are related to media type as shown in Table 3.2.2a.

Table 3.2.2a: Worst case round-trip delay for Fast Ethernet media*

Media Type	Round-trip delay in Bit Time per Meter (BT/m)
Fiber Optic	1.000
Shielded TP cable	1.112
Category 5 Cable	1.112
Category 4 Cable	1.140

*Worst case delays taken from IEEE Std 802.3u-1995, actual delays may be less for a particular cable. Contact your cable supplier for exact cable specifications.

Each shared Fast Ethernet network device also has an associated BT delay. Table 3.4b shows typical Fast Ethernet device components and the associated BT delay. Note that there is only one DTE pair associated with any device-to-device path.

Table 3.4b: Worst case round-trip delay for Fast Ethernet device components*

Component	Round-trip delay in Bit Times (BT)
2 TX DTEs	100
2 FX DTEs	100
1 FX and 1 TX DTE	100
1 T4 and 1 TX or FX DTE	127
Class I Repeater	140
Class II Repeater with any combination of TX and FX ports	92

*Worst case delays taken from IEEE Std 802.3u-1995.

To determine whether a prospective network topology adheres to the collision domain diameter specification, the following formula should be applied to the worst case path through the network. The worst case path is the path between the two Fast Ethernet devices

(DTEs) which have the longest round trip delay time.

PDV = (sum of cabling delays) + (sum of repeater & media converter delays) + (DTE pair delays) + (safety margin)

PDV is the Path Delay Value of the worst case path. For the network to adhere to IEEE 802.3u standard, this value must be less than 512 BT. The safety margin is specified in BT and may be a value between 0 and 5. This margin can be used to accommodate unexpected delays, such as an extra long patch cable. A safety margin of at least 2 to 4 BT is recommended.

"Rules-of-thumb" Collision Domain Calculations

Rules-of-thumb, while inexact, may be helpful in planning network topology. As a rule-of-thumb, a Class II Repeater has a PDV of about 90 to 95 BTs, and twisted-pair or fiber

media has a PDV of about 1 BT per meter of length. The Magnum 14E has a PDV of 20 BT. Therefore, in shared Fast Ethernet applications, the 14E uses about 80 meters of equivalent cable distance to convert from TX media to fiber FX media, i.e., it consumes almost as much of the available PDV as a Class II repeater. Since a 512BT collision domain will almost always include at least one repeater and two media segments, the remaining amount of Bit Times left after allowing for a 14E and a length of fiber media indicates that the available fiber length will be much less than the 412 meters that is the known maximum for fiber. Therefore, in shared environments, Magnum 14E Media Converters will be of benefit when they allow the use of fiber media, but not to gain distance by facilitating use of fiber media instead of twisted pair.

As a sample calculation, consider the question of what fiber cable distance (connected by a pair of Magnum 14Es on each end) can be obtained that will interconnect two 100Mb hubs where the twisted pair cables to the user nodes are 10 meters in length.

The solution is :

512 = total available Bit Times in a collision domain diameter,

minus 100 BT for two DTEs on each end leaves 412 BTs,

minus 180 BT for two Class II repeaters leaves 232 BTs,

minus 20 BT for two 10-meter TP cables for hubs to users leaves 212 BTs,

minus 10 BT for two short TP cables from the hubs to 14E's leaves 202 BTs,

minus 40 BT for two Magnum 14Es leaves 162 BTs for fiber cable,

which indicates a fiber cable length of about 160 meters.

It is obvious that using twisted pair wiring to connect the hubs would enable the interconnect length to be the 100 meters maximum for twisted pair media, and this would still leave about a hundred BTs as a safety margin. In other words, use of 14Es and fiber in this case did not gain

allowable maximum cable distance vs. TP cable without the 14Es.

Consider a more typical use of Magnum 14Es in a shared Fast Ethernet segment. A stack of Fast Ethernet hubs comprises the only repeater in the collision domain, and the users and servers in the local workgroup are each connected via Category 5 twisted pair cable, a maximum of 30 meters (100 ft.) in length. It is desired to connect one remote user with a fiber NIC via fiber cable, using a Magnum 14Es in the circuit. How long can the fiber cable be?

The solution is :
512 = total available Bit Times in a collision domain diameter,
minus 100 BT for two DTEs on each end leaves 412 BTs,
minus 90 BT for one Class II stackable repeater leaves 322 BTs,
minus 30 BT for one 30-meter TP cable from hub to user node leaves 292 BTs,
minus 5 BT for a short TP cable from the hub to 14E leaves 287 BTs,
minus 20 BT for one Magnum 14E leaves 267 BTs for fiber cable,
which indicates a fiber cable length of about 260 meters.

3.5 Connecting Fast Ethernet Media

Connecting Ethernet media to the Magnum 14E Media Converter is very simple and straightforward. Using a properly terminated media segment, simply attach the cable end to the appropriate connector. See Sections 4.2 and 4.3 for a description of the LEDs.

3.5.1 Connecting Twisted Pair (RJ-45 standard)

The following procedure describes how to connect a 100BASE-TX twisted pair segment to the RJ-45 port on the Magnum 14E Media Converters. The procedure is the same for both unshielded and shielded twisted pair segments.

1. Using standard 100BASE-TX media, insert either end of the cable with an RJ-45 plug into the RJ-45 connector of the Magnum 14E Media Converter.
2. Connect the other end of the cable to the corresponding device.
3. Use the LINK LED ensure proper connectivity by noting that the LED will be illuminated when the units are powered and proper connections established. If the LINK LED is not illuminated, change the setting of the up-link switch (See Section 4.4 for

up-link switch information.) If this does not help, ensure that the cable is connected properly at both ends and is not defective.

4. For all 14Es,the Link-Pass-through feature is standard, the two LINK LEDs operate together, and either both LEDs are lit or neither is lit. Both of the attached cables must be operable for LINK to be indicated. Absence of LINK does not point to the problem cable segment, and the fault may be in either.

3.5.2 Connecting Fiber Optic 100BASE-FX, Type ST and SC, MM and Sgl.M

The following procedure applies to 100BASE-FX applications using the Magnum 14E Media Converter with ST-type (twist-lock) and SC-type (snap-in) fiber connectors.

1. Before connecting the fiber optic cable, remove the protective dust caps from the tips of the connectors on the Magnum 14E. Save these dust caps for future use.
2. Wipe clean the ends of the dual connectors with a soft cloth or lint-free lens tissue dampened in alcohol. Make certain the connectors are clean before connecting.

Note: One strand of the duplex fiber optic cable is coded using color bands at regular intervals; you must use the color-coded strand on the associated ports at each end of the fiber optic segment.

3. Connect the Transmit (TX) port (light colored post) on the Magnum 14E to the Receive (RX) port of the remote device. Begin with the color-coded strand of the cable for this first "Transmit-to-Receive" connection.
4. Connect the Receive (RX) port (dark colored post) on the 14E to the Transmit (TX) port of the remote device. Use the non-color coded fiber strand for this.
5. The LINK LED corresponding to the fiber port, on the front of the product, will illuminate when a proper connection has been established at both ends (and when power is ON in the units at each end). If LINK is not lit after cable connection, the normal cause is improper cable polarity. Swap the fiber cables on the product connector to remedy this situation.
6. Because of standard Link Pass Through feature the LINK indication will not be present unless LINK is made for the cables on both sides.

3.5.3 Connecting Fiber Optic 100BASE-FX, Type MT-RJ Small Form Factor

The following procedure applies to 100BASE-FX applications using the Magnum 14E Media Converter with MT-RJ (snap-in, two-fibers-in-one-piece) fiber connectors.

www . GarrettCom . com

1. Before connecting the fiber optic cable, remove the protective dust cap from the tip of the connector on the Magnum 14E.
2. Wipe clean the ends of the connector with a soft cloth or lint-free lens tissue dampened in alcohol. Make certain the connector is clean before connecting.
   Note: The MT-RJ connector is keyed so that it will only plug in when both TX and RX fiber elements are correctly positioned.
3. Insert the male MT-RJ part into the female MT-RJ port. This connection is keyed so that it only goes in one way, aligning the fiber pair for transmit and receive.
4. The LINK LED corresponding to the fiber port, on the front of the product, will illuminate when a proper connection has been established at both ends (and when power is ON in the units at each end). If LINK is not lit after cable connection, the normal cause is improper cable seating. Re-insert the fiber cables on the product connector to possibly remedy this situation.
5. Because of standard Link Pass-through feature, the LINK indication will not be present unless LINK is made for the cables on both sides.

4.0 OPERATION

This section describes the operation of the Magnum 14E Media Converters including power supply, up-link switch and AN/reg functionality, and LEDs.

4.1 Power Requirements, Power Supply Types

Magnum 14E Media Converters require 4 watts of power and are designed to be used with an external power supply. The external power supply unit supplied is one of two types; one version ("-d" models) for AC input power of 115 vac 60 Hz, and one version for 230 vac 50 Hz. The 115 vac version has a small transformer integral with a convenience power outlet plug. The 230 vac version ("-i" models) has a small transformer integral with an IEC-type power plug for a user-supplied AC power cord with a convenience power outlet plug. Both types include a lightweight DC power cord to the applicable power jack on the Media Converter unit.

4.2 Dual LED Indicators (front and side-panel LEDs)

LED	Description
PWR	Illuminates GREEN to indicate the unit is receiving DC power.

Note: Magnum 14E has Link Pass-through feature, see Section 4.5

LINK, Fiber port	Steady ON when both attached cable segments are operational at their respective other ends, blinking when receiving remote fault from the other end.
LINK, Copper port	Steady ON when the attached cable segments are operational at their respective other ends
RX/ACT	Activity, blinking indicates port is receiving

4.3 Up-Link or "Cross-over" Switch (On the RJ-45 port)

Magnum 14E Media Converters are equipped with an up-link slide switch to accommodate switch- or repeater-to-converter connections without a special cross-over cable. When set to the straight position (=), the Magnum 14E Media Converter is wired for normal twisted pair connection to a user node device. When set to the cross-over position (X), the Media Converter is wired with cross-over functionality for direct up-link to a network hub or switch.

See Figure 4.4 below for the location of the switch on the Magnum 14E Media Converter unit.

4.4 Manual AN / reg Switch (Auto-negotiate or Full-duplex Fixed 100Mb)

Magnum 14E Media Converters are equipped with a manual switch on the RJ-45 copper port. It is located just underneath the up-link switch, and is very tiny. See Figure 4.4 below.

The AN / reg switch provides the flexibility to the user to manually select either (a) **A**uto-**N**egotiation support to send Fast Link Pulses (FLP's) to the attached device, or (b) **reg** mode for regular or normal operation. In all cases, the unit functions at both FDX and HDX transparently, but always at 100Mbps speed. The factory default setting is **AN** (Auto-Negotiation).

The difference in the two settings is for the attached port, i.e., the port in the switch or hub or NIC at the other end of the twisted pair cable. If the attached port is of the increasingly popular auto-negotiate-only variety, it needs to get FLPs from the 14E Media

Converter in order to decide what to do. Not receiving FLPs would indicate (incorrectly) that the Magnum 14E is only capable of half-duplex operation. Setting the switch in the AN position causes FLPs to be sent, advertising full-duplex capability. **BUT NOTE** . . . it is up to the user who chooses the AN position to determine that the device on the other end of the fiber cable is, in fact, capable of full-duplex operation. If it is not, choose the **reg** position and do not advertise full-duplex.

The **reg** position is also suitable for use when non-auto-negotiating devices are attached. In this case, the attached RJ-45 port (such as in a traditional managed switch) is set to half-or full-duplex by the operator, and does not depend upon auto-negotiating FLPs. The 14E itself is transparent half- or full-duplex, and will always operate correctly in this situation.

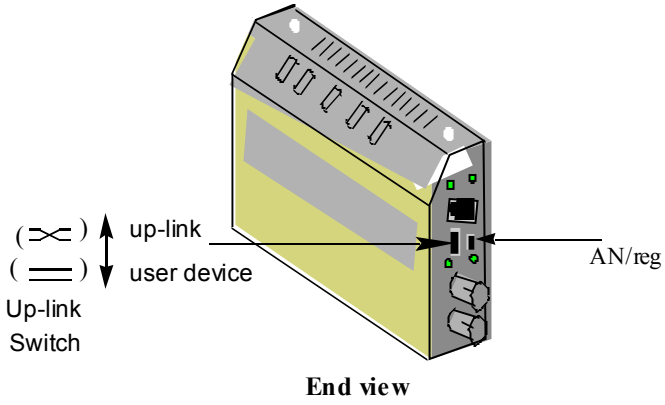
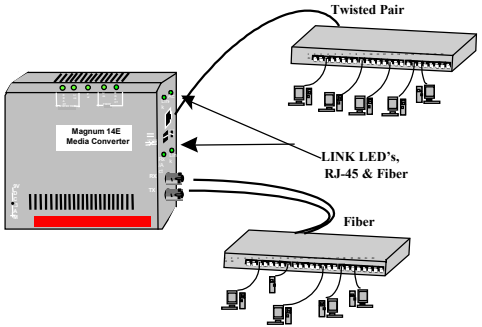


Figure 4.4 End View of the 100Mb Magnum 14E Media Converter

4.5 Standard LINK Pass-Through feature in 14E:

A LINK Pass-through feature is standard in all Magnum 14E's. It works one way only, i.e., RJ-45 LINK status pass-through to fiber, in order not to interfere with the auto-negotiation feature if it is turned on



LINK Pass-through on 14E's allows network devices attached to the RJ-45 port to sense the LINK status of the attached copper cable along with the devices attached to both ends. When LINK is ON for the copper cable, that status is passed to the fiber port's LINK indicator of the 14E, and if the

LINK is valid on the fiber segment, then LINK is ON for both ports of the 14E.

If LINK is not present on the copper side but is valid for the fiber side, the Pass-through feature causes the LINK LED on the fiber port to blink rapidly to indicate there is a LINK problem elsewhere. If LINK Receive is invalid on the fiber side, LINK will be OFF on Fiber and ON for copper because the Pass-through does not apply to fiber-to-copper.

Each LINK LED, then, may be OFF or ON or Blinking. If it is Blinking, the Pass-through feature is indicating a LINK problem on another cable segment and you should check the cable connections and device power-on conditions accordingly.

5.0 TROUBLESHOOTING

All Magnum Ethernet products are designed to provide reliability and consistently high performance in all network environments. The installation of Magnum 14E Media Converters is a straightforward procedure (see INSTALLATION, Section 2.6); the operation is also straightforward and is discussed in Section 4.

Should problems develop during installation or operation, this section is intended to help locate, identify and correct these types of problems. Please follow the suggestions listed below prior to contacting your supplier. However, if you are unsure of the procedures described in this section or if the Magnum 14E Media Converters is not performing as expected, do not attempt to repair the unit; instead contact your supplier for assistance or contact GarrettCom Customer Support.

5.1 Before Calling for Assistance

1. If difficulty is encountered when installing or operating the unit, refer back to the installation Section of the applicable chapter of this manual. Also check to make sure that the various components of the network are interoperable.
2. Check the cables and connectors to ensure that they have been properly connected and the cables/wires have not been crimped or in some way impaired during installation. (About 90% of network downtime can be attributed to wiring and connector problems.)
3. Make sure that an AC power cord is properly attached to each Magnum 14E Media Converter unit. Be certain that each AC power cord is plugged into a functioning electrical outlet. Use the PWR LEDs to verify each unit is receiving power.
4. If the problem is isolated to a network device other than the Magnum 14E Media Converters product, it is recommended that the problem device is replaced with a known good device. Verify whether or not the problem is corrected. If not, go to Step 5 below. If the problem is corrected, the Magnum 14E Media Converters and its associated cables are functioning properly.

5. If the problem continues after completing Step 4 above, contact your supplier of the Magnum 14E Media Converters unit or if unknown, contact GarrettCom, Inc.by fax, phone or email (*support@garrettcom.com*) for assistance.

5.2 When Calling for Assistance

Please be prepared to provide the following information.

1. A complete description of the problem, including the following points:
   a. The nature and duration of the problem;
   b. Situations when the problem occurs;
   c. The components involved in the problem;
   d. Any particular application that, when used, appears to create the problem;
2. An accurate list of GarrettCom product model(s)involved, with serial number(s). Include the date(s) that you purchased the products from your supplier.
3. It is useful to include other network equipment models and related hardware, including personal computers, workstations, terminals and printers; plus, the various network media types being used.
4. A record of changes that have been made to your network configuration prior to the occurrence of the problem. Any changes to system administration procedures should all be noted in this record.

5.3 Return Material Authorization (RMA) Procedure

All returns for repair must be accompanied by a Return Material Authorization (RMA) number. To obtain an RMA number, call GarrettCom Customer Service at (510) 438-9071 during business hours in California or email to *support@garrettcom.com*). When calling, please have the following information readily available:

Name and phone number of your contact person.
Name of your company / institution
Your shipping address
Product name
Serial Number (or Invoice Number)
Packing List Number (or Sales Order Number)
Date of installation
Failure symptoms, including a full description of the problem.

GarrettCom will carefully test and evaluate all returned products, will repair products that are under warranty at no charge, and will return the warranty-repaired units to the sender with shipping charges prepaid (see Warranty Information, Appendix A, for complete details). However, if the problem or condition causing the return cannot be duplicated by GarrettCom, the unit will be returned as:

No Problem Found.

GarrettCom reserves the right to charge for the testing of non-defective units under warranty. Testing and repair of product that is not under warranty will result in a customer (user) charge.

5.4 Shipping and Packaging Information

Should you need to ship the unit back to GarrettCom, please follow these instructions:

1. Package the unit carefully. It is recommended that you use the original container if available. Units should be wrapped in a "bubble-wrap" plastic sheet or bag for shipping protection. (You may retain all connectors and this Installation Guide.)

CAUTION: Do not pack the unit in Styrofoam "popcorn" type packing material. This material may cause electro-static shock damage to the unit.

2. Clearly mark the Return Material Authorization (RMA) number on the outside of the shipping container.
3. GarrettCom is not responsible for your return shipping charges.
4. Ship the package to:

GarrettCom, Inc.
213 Hammond Ave.
Fremont, CA 94539
Attn.: Customer Service

APPENDIX A: WARRANTY INFORMATION

GarrettCom, Inc. warrants its products to be free from defects in materials and workmanship for a period of three (3) years from the date of shipment by GarrettCom.

During this warranty period, GarrettCom will repair or, at its option, replace components in the products that prove to be defective at no charge other than shipping and handling, provided that the product is returned pre-paid to GarrettCom.

This warranty will not be effective if, in the opinion of GarrettCom, the product has been damaged by misuse, misapplication, or as a result of service or modification other than by GarrettCom.

GarrettCom reserves the right to make a charge for handling and inspecting any product returned for warranty repair which turns out not to be faulty.

Please complete the warranty card as this acts as a product registration, and mail it to GarrettCom within two weeks of your purchase.